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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/743,793	12/24/2003	Katsuto Tanahashi	032206	9788

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EXAMINER

MONDT, JOHANNES P

ART UNIT	PAPER NUMBER
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3663

DATE MAILED: 07/21/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/743,793

Applicant(s)

TANAHASHI ET AL.

Examiner

Johannes P. Mondt

Art Unit

3663

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 May 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 4-14 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 and 4-14 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Response

Response filed 5/3/06 forms the basis for this office action. In said Response submitted with Remarks applicant traversed the rejections in the office action mailed 1/4/06 based on an alleged showing of "unexpected results". Comments on Remarks are included below under "Response to Arguments".

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. **Claims 1, 4-6 and 14** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yonehara et al (US 2003/0159644 A1) in view of prior art as admitted by Applicants ("APAA"). Yonehara et al teach a semiconductor substrate 1 ([0075] and [0113]) comprising a front face and a rear face that are both mirror-polished ([0095]), wherein said semiconductor substrate contains boron at a concentration in the range $1 \times 10^{17} - 10^{20} \text{ cm}^{-3}$ (see [0149]) which range overlaps the claimed range in the sub-range $10^{17} - 2 \times 10^{17} \text{ cm}^{-3}$. In this regard it is noted that a *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art or when the ranges of a claimed composition do not

overlap but are close enough such that one skilled in the art would have expected them to have the same properties. In re Peterson, 65 USPQ2d 1379 (CA FC 2003).

Yonehara also teach that a crystal layer **10** is provided on the front face ([0150]), and that a minimum value of the concentration of boron, [B] (in atoms/ cm³) is defined for a required thickness, "t" (in μm), said required thickness being $t=100\text{ nm}=0.1\text{ }\mu\text{m}$ (see [0150]) of the crystal layer that satisfies the inequality as claimed, said minimum concentration being $[B]=10^{17}\text{ cm}^{-3}$ (see [0149]), because $\exp(0.21 \times 0.1) \cong 1.021 \leq 10^{17} / [(2.2 \pm 0.2) 10^{16}] \cong R$, wherein $4.17 \leq R \leq 5$ within 1% accuracy. *(N.B.: please note that an upper portion of the crystalline layer 3 is porous and hence is (1) another layer and (2) not truly crystalline when taken as a whole, because the porosity destroys the translational symmetry along the lattice vectors which is a defining property of crystallinity). Yonehara et al do not necessarily teach the limitation that said semiconductor substrate meets a criterion of "an SFQR value $\leq 70\text{ nm}$ as a flatness of the front face". However, as admitted by Applicants as many as 40% of all conventionally produced wafers satisfy said criterion and therefore, by rule of statistics all one of ordinary skills in the art has to do is make enough of said wafers in order to be certain to have one that satisfies said criterion. With regard to claim 14, in addition Yonehara et al teach a semiconductor element formed on the front face of said semiconductor substrate (solar battery: see Figures 16 and [0072]).*

On claim 4: a maximum value of a thickness of the crystal layer 10 is defined by Yonehara to be $20\text{ }\mu\text{m}$ (see [0150]), which does satisfy the claimed inequality for a required concentration of boron [B] (in atoms/cm³), said concentration being required to

be in the interval $10^{17} - 10^{20} \text{ cm}^{-3}$ (see [0149]), hence 10^{20} being one of all required values, because $\exp(0.21 \times 20) = \exp(4.2) \cong 66.7 \leq 4166 \leq 10^{20} / (2.2 \pm 0.2) \times 10^{16} \leq 10^{20} / (2.2 \pm 0.2) \times 10^{16}$.

On claim 5: the crystal layer 10 is a silicon crystal layer ([0078]) formed by epitaxial growth ([0149]).

On claim 6: the crystal layer is a silicon-germanium alloy crystal layer ([0078]).

3. **Claims 7-11** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yonehara and APAA as applied to claim 2 above, and further in view of Fitzgerald (US 2002/0123167 A1). As detailed claim 2 is unpatentable over Yonehara et al in view of APAA. Neither necessarily teach the claimed layered structure of SiGe and Si. However, (a) there is a specific suggestion by Yonehara et al that a layered structure of SiGe on silicon could be used to generate stress in an SOI structure ([0411]-[0412]), while Fitzgerald teaches an SOI structure with a layered SOI composition, in particular SiGe on Si (Figure 1) for the specific purpose to enhance electron mobility (see "Background of the Invention"). *Motivation* to follow the suggestion by Yonehara et al and the teaching by Fitzgerald immediately derives from the improved electron mobility and consequent higher operational speed.

On claims 8 and 9, both Yonehara et al ([0411]-[412] and Fitzgerald ([0032] and Figures 4) teach the silicon layer to be formed in an SOI structure, i.e., inherently a structure in which the silicon crystal layer is separated by a silicon oxide layer, i.e., said semiconductor substrate is an SOI substrate wherein the crystal layer is an upper silicon crystal layer separated by a silicon dioxide layer (loc.cit.).

On claim 10: while Yonehara et al teach SIMOX as a method in the prior art for making an SOI substrate ([0006]) Applicant is reminded that the limitation of claim 10 fails to further limit the device and instead only further limits the method of making. Therefore, the further limitation defined by claim 10 fails to distinguish over the prior art.

On claim 11: similarly, while Yonehara et al teach bonding steps the limitation of claim 11 fails to further limit the device but instead only limits its method of making. Hence the further limitation fails to distinguish over the prior art.

4. **Claim 12** is rejected under 35 U.S.C. 103(a) as being unpatentable over Yonehara et al as and APAA applied to claim 1 above, and further in view of Hurley (5,698,474).

As detailed above, claim 1 is unpatentable over Yonehara et al in view of APAA, neither necessarily teaching the further limitation defined by claim 12.

However, it would have been obvious to include said further limitation in view of Hurley, who, in a patent on semiconductor wafer manufacturing for integrated circuits, hence analogous art, teaches exposing the entire backside as a flat, thinned and mirror polished for the specific purpose of creating a window suitable for inspection (see title, abstract and col. 5, lines 8-12). Motivation for the inclusion of the teaching by Hurley in this regard in the invention by Yonehara derives from the need to inspect the quality of the result of the manufacturing process.

5. **Claim 13** is rejected under 35 U.S.C. 103(a) as being unpatentable over Yonehara et al and APAA as applied to claim 1 above, and further in view of Steckl et al (5,759,908). As detailed above, claim 1 is unpatentable over Yonehara et al in view of

APAA. Neither necessarily teach the further limitation defined by claim 13. However, it would have been obvious to include SiC as a substrate material for an SOI in view of Steckl et al, who teach silicon carbide SOI structures (title, abstract) for the specific purpose of *inter alia* its higher breakdown voltage (see col. 1, l. 10-22). *Motivation* to replace the silicon substrate with the silicon carbide substrate derives immediately from said higher breakdown voltage.

Response to Arguments

Applicant's arguments filed 5/3/06 have been fully considered but they are not persuasive.

Applicants allege: "unexpected superior results associated with the claimed range of boron concentration" (page 2 of Remarks). However,

(1) the rejection of record rejected the claimed range of boron concentrations based on a *teaching* by Yonehara et al, as the range claimed and the prior art range very substantially overlap; and, even arguendo,

(2) said claimed range is, counter to applicants' allegation (page 3, line 1), far from "narrow": the range as disclosed (page 25 in specification) is a broad, thickness-dependent range that is unlimited from above. Applicants erroneously allege that "the reference teaches a broad range" (page 3, lines 1-2): the thickness in the reference corresponding to the "required thickness" as claimed is between 100 nm and 20 μm ([0150]) while the boron concentration is 10^{17} cm^{-3} to 10^{20} cm^{-3} ([0149]). The mean thickness (10.05 μm), within the range of the reference, and the mean boron

Art Unit: 3663

concentration ($\cong 5 \times 10^{19} \text{ cm}^{-3}$), within the range of the reference, together, meet the range as claimed: $5 \times 10^{19} \geq (\text{a number between } 2.0 \text{ and } 2.4) \times 10^{16} \times \exp(0.21 \times 10.05)$ (N.B.; the overall factor in front of 10^{16} on the right hand side being between about 16 and about 19, hence the left hand side stands to the right hand side as about 5000 stands to a number less than 20). Furthermore, the few samples provided in the specification fall far short of providing evidence of “unexpected results” over the entire range as claimed, especially because for every thickness a convincing set of boron concentrations are required to cover the sample space of the range as claimed. In conclusion then, applicants at best have a few samples within a broad range while said broad range quite substantially overlaps with the range as found in the prior art. Applicant is reminded in this regard that the “unexpected results” must be “commensurate in scope with the claimed invention” (cf. MPEP 716.02 (d)). Finally, on applicants’ recognition of unexpected results,

“The fact that appellant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious.” *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985) (The prior art taught combustion fluid analyzers which used labyrinth heaters to maintain the samples at a uniform temperature. Although appellant showed an unexpectedly shorter response time was obtained when a labyrinth heater was employed, the Board held this advantage would flow naturally from following the suggestion of the prior art.). See also *Lantech Inc. v. Kaufman Co. of Ohio Inc.*, 878 F.2d 1446, 12 USPQ2d 1076, 1077 (Fed. Cir. 1989), *cert. denied*, 493 U.S. 1058.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P. Mondt whose telephone number is 571-272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack W. Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JPM
July 15, 2006

Patent Examiner:

A handwritten signature in black ink, appearing to read 'JPM', followed by two dots.

Johannes Mondt (Art Unit: 3663).